Amendments to the Specification:

IN THE SPECIFICATION:

Please replace paragraphs **[0004]**, **[0009]** – **[0011]**, **[0013]**, **[0016]**, **[0018]**, **[0019]**, **[0026]**, **[0037]**, **[0039]**, **[0042]**, **[0051]** – **[0054]**, **[0056]**, **[0057]**, **[0060]**, **[0061]**, **[0068]**, **[0079]**, **[0080]**, **[0082]**, **[0083]**, **[0086]**, **[0088]**, **[0092]**, **[0094]**, **[0095]**, **[0099]**, **[0101]** – **[0103]** and **[0106]** as follows:

[0004] (1) An operator assisting apparatus for assisting an operator of an electric-component supply device including a plurality of component feeders and feeder support on which the component feeders are mounted at respective feeder-mounting positions, each of the component feeders accommodating a plurality of electric components of a specific kind and being arranged to successively supply the electric components one after another, the operator assisting apparatus being arranged to assist the operator in performing at least one manual working operation selected from among an operation to mount the component feeders on the feeder support, an operation to remove the component feeders from the feeder support, and an intermediate operation to be performed in connection with the component feeders, during a time period between moments of the operations to mount and remove the component feeders on and from the feeder support, the operator assisting apparatus comprising:

at least one of (a) a position indicator operable to indicate at least one of the feeder-mounting position at which a corresponding one of the component feeder is to be mounted next on the feeder support and the feeder-mounting position at which a corresponding one of the component feeders has been removed last from the feeder support, and (b) a feeder indicator operable to indicate at least one of (i) the component feeder which has been mounted last on the feeder support, (ii) the component feeder which is to be removed next from the feeder support and (iii) the component feeder on which the intermediate operation is required to be performed.

[0009] The mounting-position checking and indicating device may include a detecting device of non-contact type operable to effect the above-indicated determination, without a contact with the relevant component feeder, or a detecting device of contact type operable to effect the above-indicated determination, by contacting the relevant component feeder. The detecting device of non-contact type is preferably selected from among various proximity switches, and various photoelectric switches of light-reflecting or light-transmission type each including a light-emitting element and a light-receiving element.

[0010] The mounting-position checking and indicating device provides an indication that the relevant component feeder has been mounted at the wrong ~~component-mounting~~ feeder-mounting position, so that the mounting of the component feeder at the wrong feeder-mounting position can be prevented with increased reliability. When the mounting-position checking and indicating device has provided the indication that the relevant component feeder has been mounted at the wrong feeder-mounting position, the feeder indicator and the position indicator may be arranged not to provide a next indication of any component feeder or any feeder-mounting position, unless the mounting-position checking and indicating device has determined that the relevant component feeder has been re-mounted by the operator at the correct feeder-mounting position.

[0011] (4) An operator assisting apparatus according to the above mode (3), which comprises the feeder indicator, and wherein the mounting-position checking and indicating device utilizes the ~~position~~ feeder indicator, to indicate the result of said determination.

[0013] (5) An operator assisting apparatus according to the above mode (4), wherein the mounting-position checking and indicating device is operable to control the feeder indicator to be operable in a ~~first mode~~ last-mounting upon a ~~first~~ last-mounting determination that the component feeder mounted last on the feeder support has been mounted at the correct feeder-mounting position, and in a ~~second mode~~ non-last-mounting different from the ~~first~~ last-mounting mode, upon a ~~second~~ non-last-mounting determination that the component feeder mounted last on the feeder support has not been mounted at the correct feeder-mounting position.

[0016] (7) An operator assisting apparatus according to ~~claim~~ any one of the above modes (1)-(6), which comprises the position indicator, and further comprises a removing-position checking and indicating device operable to control the position indicator to be operable in a ~~third mode~~ removing manner upon a ~~third~~ removing determination that the component feeder removed last from the feeder support has been removed from a correct one of the feeder-mounting positions, and in a ~~fourth mode~~ non-removing manner different from the ~~third mode~~ removing manner, upon a ~~fourth~~ non-removing determination that the component feeder removed last from the feeder support has not been removed from the correct feeder-mounting position.

[0018] (9) An operator assisting apparatus according to any one of the above modes (1)-(8), which comprises the feeder indicator, and further comprises:

a need detecting device operable to detect a need of performing the intermediate operation;

an operation detecting device operable to detect that said intermediate operation has been performed in connection with any one of said component feeders; and

an intermediate-operation checking and indicating device operable according to an output of the ~~need~~ operation detecting device, to control the feeder indicator for indicating the component feeder in connection with which the intermediate operation has been performed, such that the feeder indicator is operable in ~~a fifth mode~~ an intermediate manner upon ~~a fifth~~ an intermediate determination that the intermediate operation has been performed at a correct one of the feeder-mounting positions, and a ~~sixth mode~~ non-intermediate different from the ~~fifth mode~~, upon a ~~sixth~~ non-intermediate determination that the intermediate operation has not been performed at the correct feeder-mounting position.

[0019] (10) An operator assisting apparatus according to any one of the above modes (1)-(9), which comprises the feeder indicator, and further comprises:

a need detecting device operable to detect a need of performing the intermediate operation;

an operation detecting device operable to detect that the intermediate operation has been performed in connection with any one of the component feeders; and

an intermediate-operation checking and indicating device operable according to an output of the need detecting device, to control the feeder indicator to be operable in a ~~seventh mode~~ needing manner upon a ~~seventh~~ needing determination that the intermediate operation which has been performed ~~has been performed~~ is the intermediate operation the need of which has been detected by the need detecting device, and in ~~an eighth mode~~ a non-needing different from the ~~seventh mode~~ needing manner, upon ~~an eighth~~ a non-needing determination that the intermediate operation which has been performed is different from the intermediate operation the need of which has been detected by the need detecting device.

[0026] The ~~feeder identification data~~ position-identification-data obtaining means may be identification-code reading means for reading identification codes provided at the respective feeder-mounting positions, or identification-data reading means for reading from memory means the position-identification data sets representative of the respective feeder-mounting positions, according to a predetermined rule. Alternatively, the position-identification-data obtaining means may be identification-data receiving means for receiving from an external device the position-identification data sets representative of the feeder-mounting positions. The identification-code reading means may be a code reader, such as a bar code reader, which is operated by the operator. The identification-data reading means may be means for executing a control program prepared for controlling an electric-

component mounting system including the present operator assisting apparatus. The external device from which the ~~feeder identification~~ position-identification data sets are received by the identification-data receiving means may be an input device operable by the operator, or a host computer. The position-identification data may be located on the feeder support such that the set of position-identification data is not readable when the corresponding component feeder is mounted on the feeder support, or such that the set of position-identification data is readable even after the corresponding component feeder is mounted on the feeder support.

[0037] The feeder body 106 is a generally elongate plate disposed on the table 22, 23 such that the directions of length and thickness of the plate are parallel to a horizontal plane. A cover 110 is disposed so as to extend in parallel with the upper surface of the feeder body ~~107~~ 106, and a leading end portion of the carrier tape 100 is inserted between on the upper surface of the feeder body 106 and under the cover 110. The carrier tape 100 is intermittently fed on the upper surface of the feeder body 106 by a predetermined incremental distance in the Y-axis direction (perpendicular to the X-axis direction and parallel to the direction of length of the feeder body 106), by a feeding device 112 which will be described. The direction of length of the feeder body 106 is parallel to the direction of feeding of the carrier tape 100 by the tape feeder 20, and the direction of thickness (width) of the feeder body 106 is parallel to the direction of movement of the first and second tables 22, 23. The feeding device 112 is arranged to feed the carrier tape 100 in the forward direction by the predetermined distance, together with the cover 110, and move only the cover 110 in the reverse direction by the same distance with the carrier tape 100 held stationary, so as to prepare for the next cycle of feeding of the carrier tape 100. Thus, the cover 110 is reciprocated in each cycle of feeding.

[0039] The feeding device 112 and the covering-tape take-up device 120 are driven by a drive device which utilizes the table indexing servomotor 38 as a drive source. That is, the drive device includes a motion converting mechanism which includes a cam and a cam follower and which is arranged to convert a rotary motion of the table indexing servomotor 38 into a vertical reciprocating movement of an elevator member (not shown) so that an input bar 126 attached to the bracket 122 is vertically reciprocated to operate the feeding device ~~122~~ 112 and the take-up device ~~126~~ 120. Since the feeding of the carrier tape 100 and the operation to take up the covering tape 102 do not directly relate to the present invention, no further description is deemed necessary.

[0042] The first table 22 has a main body formed of an aluminum alloy, and a first and a second feeder positioning plate 160, 162 fixed on the upper surface of the main body, at

the front and rear end portions of the main body, respectively, so as to extend in the ~~X-axis~~ direction, as shown in Figs. 3 and 4. Like the mounting member 150, these first and second feeder positioning plates 160, 162 are formed of a carbon steel material (S50C) suitable for a mechanical structure, and hardened. As shown in Fig. 3, these first and second feeder positioning plates 160, 162 have respective first and second positioning grooves 163, 164 formed so as to extend in the Y-axis direction. The first positioning grooves 163 for the respective tape feeders 20 are arranged at a same spacing pitch as that of the tape feeders 20 in the X-axis direction. The second positioning grooves 164 are similarly arranged in the X-axis direction. Each of the first and second positioning grooves 163, 164 has a width slightly larger than a thickness of the first and second positioning projections 152, 154, and a depth larger than the height of the projections 152, 154, so that the positioning projections 152, 154 of the feeder body 106 are fitted in the respective positioning grooves 163, 164 when the corresponding tape feeder 20 is mounted on the first table 22. The upper surfaces of the first and second feeder positioning plates 160, 162 serve as bearing surfaces for supporting the corresponding feeder 20. The first feeder positioning plate 160 for each tape feeder 20 has through-holes 165 formed through its front end portion, so as to extend in a Z-axis direction perpendicular to the X-axis and Y-axis directions, as shown in Figs. 3 and 4.

[0051] The present electronic-component mounting system 12 uses the control device 300 as shown in the block diagram of Fig. 5. The control device 300 is principally constituted by a computer 310 incorporating a central processing unit (CPU) 302, a read-only memory (ROM) 304, a random-access memory (RAM) 306 and a bus 308 interconnecting these elements 302, 304 and 306. To the bus 308, there is connected an input interface 312, which is connected to the photoelectric sensors ~~322~~ 222, 242 of the operator-assisting apparatus 200, an input device in the form of an operator's control panel 314 and a bar code reader 316. To the bus 308, there are also connected an output interface 318 and a servo interface 320. To the servo interface 320, there are connected the servomotors 30, 31, 38, 60 and 76. To the output interface 318, there are connected the LED 210 and a display device 330 of the operator-assisting apparatus 200. The ROM 304 stores various programs such as those for controlling the electronic-component mounting device 14, and various operator-assisting programs to control the operator-assisting apparatus 200 as illustrated in Figs. 6 and 7.

[0052] There will next be described the manual working operations to be performed by the operator to remove and mount the tape feeders 20 from and on the first and second tables 22, 23, in the electronic-component mounting system 12 constructed as described

above. For instance, each of the first and second tables 22, 23 carries an array of tape feeders 20 which accommodates a set of electronic components to be mounted on the printed-wiring board 16 to produce the same printed-circuit board. To repeatedly perform the operations to mount the electronic ~~operations~~ components successively on a multiplicity of printed-wiring boards 16, the first and second tables 22, 23 are alternately used such that one of these two tables 22, 23 is positioned in the above-indicated common component-supply area of the tables 22, 23, while the other table is located at its standby position. Each of the tape feeders 20 presently mounted on the table 22 or 23 is replaced by the new tape feeder 20, when all of the electronic components accommodated in the presently mounted tape feeder 20 have been used, or when the number of the electronic components left in the presently mounted tape feeder 20 has become smaller than a predetermined lower limit. Where the first and second tables 22, 23 carry respective arrays of tape feeders 20 which accommodate respective sets of electronic components to be mounted on the printed-wiring board 16 to produce respective different printed-circuit boards, a setup changeover of the tape feeders 20 on one of the tables 22, 23 is effected when the number of the printed-circuit boards produced by the electronic components supplied form that table has reached a predetermined value.

[0053] Initially, there will be described the case where all of the electronic components accommodated in the presently mounted tape feeder 20 have been used, or where the number of the electronic components left in the presently mounted tape feeder 20 has been become smaller than the predetermined lower limit. In the present embodiment, the control device 300 is adapted to determine that all of the electronic components in each tape feeder 20 have been used, if the component mounting head 34 have failed to receive an electronic component from that tape feeder 20, for two times consecutively. The control device 300 is further adapted to: store in the RAM 306 of the computer 310 number data indicative of the number of the electronic components accommodated in each tape feeder 20, together with an identification code representative of that tape feeder 20, when a component mounting operation is initiated by the electronic-component mounting device 14, or when the tape feeder 20 is set up on the table 22, 23; count the number of the electronic components that have been supplied from each tape feeder 20; and monitor the number of the electronic components remaining in each tape feeder 20. When the control device 300 detects in a main control routine that all of the electronic components in a given tape feeder 20 have been supplied therefrom or ~~when~~ that the number of the electronic components remaining in the tape feeder 20 has become smaller than the lower limit, the control device 300 determines a need of replacing the presently mounted tape feeder 20 with a new one, and provides an

indication of this replacement. To indicate the replacement, the control device 300 controls the display device 330 to provide data indicative of the name (identification code) of the presently mounted tape feeder 20 and the new tape feeder 20, and data indicative of the position of the corresponding indicator-detector unit 208 (hereinafter referred to as "relevant indicator-detector unit 208"). Referring to the flow chart of Fig. 6, a feeder replacement assisting program to be executed by the computer 310 will be described.

[0054] The feeder replacement assisting program of Fig. 6 is executed when the control device 300 has detected in the main control routine that all of the electronic components in a given tape feeder 20 have been used or ~~when~~ that the number of the electronic components remaining in the tape feeder 20 has become smaller than the lower limit. The feeder replacement assisting program is initiated with step S1 to determine whether a flag F1 is set at "0". If an affirmative decision (YES) is obtained in step S1, the control flow goes to step S2 to determine that the relevant tape feeder 20 is required to be replaced. Step S2 is followed by step S3 in which the display device 330 provides an indication of a need of replacement of the tape feeder 20 on its display screen. Then, the control flow goes to step S4 to move the relevant table 22, 23, for instance, the first table 22 from the common component-supply area to the standby position, and move the second table 23 into the common component-supply area so that the second table 23 is used for the component mounting operation.

[0056] If a tape feeder 20 other than the relevant tape feeder 20 has been removed by error, the output signal of the photoelectric sensor 222 of the indicator-detector unit 208 corresponding to the erroneously removed tape feeder 20 indicates the removal of this wrong tape feeder 20, so that a negative decision (NO) is obtained in step S7 to indicate the removal of the wrong tape feeder 20. In this case, the control flow goes to step S8 to activate the first and second irradiating devices 202, 204 corresponding to the wrong tape feeder 20 such that the irradiating devices 202, 204 flicker to inform the operator that the wrong tape feeder 20 has been removed. In this case, one cycle of execution of the program of Fig. 6 is terminated. In the next cycle in which the flag F1 is set at "1", a negative decision (NO) is obtained in step S1, and the control goes to step S7 while skipping steps S2-S6. Steps S1, S7 and S8 are repeatedly implemented until the affirmative decision (YES) is obtained in step S7.

[0057] In the present embodiment, the new tape feeders 20 are stored at a suitable storage location outside the present electronic-component mounting system 12. When the new tape feeder 20 is mounted or set up on the first table 22, the operator operates the bar code reader 316 to read a bar code attached to this new tape feeder 20, and then mounts this

new tape feeder 20 in the relevant slot 180 on the first table 22. This relevant slot 180 is indicated by the ~~flicking~~ irradiating operations of the first and second irradiating devices 202, 204 of the relevant indicator-detector unit 208, so that the operator can find the relevant slot 180 and can correctly mount the ~~net~~ new tape feeder 20 in this relevant slot 180, even where the other slots 180 are empty. When the new tape feeder 20 is mounted on the first table 22, a bar code attached to the carrier tape 100 accommodated in the tape feeder 20, and the bar code on the tape feeder 20 per se are both read by the bar code reader, and stored in the RAM 306 of the control device 300.

[0060] If the bar code read by the bar code reader 316 does not identify the position of the relevant slot 180, a negative decision (NO) is obtained in step S9, and the control flow goes to step S13 to turn off the first and second irradiating devices 202, 204 of the relevant indicator-detector unit 208, to inform the operator that the new tape feeder 20 mounted in the relevant slot 180 does not match this slot 180, that is, a wrong tape feeder 20 has been newly mounted. In this case, the operator removes the mounted new tape feeder 20, operates the bar code reader 316 to read the bar code attached to the correct new tape feeder 20,and mounts this correct tape feeder 20 in the relevant slot 180. As a result, the affirmative decision (YES) is obtained in step S9, and the first and second irradiating devices 202, 204 are turned on in step S10, so that the operator can confirm that the correct new tape feeder 20 has been mounted. If the new tape feeder 20 is not mounted in the relevant slot 180, that is, is mounted in the wrong slot 180, this erroneous mounting of the new tape feeder 20 is detected by the photoelectric sensor 222 of the unit 208 corresponding to the wrong slot 180, so that the negative decision (NO) is obtained in step S11. In this case, the control flow goes to step S8 to activate the irradiating devices 202, 204 corresponding to the wrong slot 180, such that the irradiating devices 202, 204 flicker, informing the operator of the erroneous mounting of the new tape feeder 20 in the wrong slot 180. When the operator re-mounts the new tape feeder 20 in the correct slot 180 in which the visible light generated by the second irradiating device 204 is visible through the through-hole 165, the irradiating devices 202, 204 are turned off in step S12, and one cycle of execution of the feeder replacement assisting program is terminated. In this state, the first table 22 is held at the standby position, until the first table 22 is commanded to be moved to the common component-supply area, and operate to supply the electronic components, in place of the second table 23.

[0061] The supply reel 104 is removed from the used tape feeder 20 which has been removed from the first table 22, and replaced with the new supply reel 104 accommodating a new roll of the carrier tape 100. Further, the covering tape 102 wound on the take-up reel-

~~102~~ 124 in the removed tape feeder 20 is removed, and the covering tape 102 of the carrier tape 100 of the new supply reel 104 is connected at its leading end to the take-up reel ~~102~~ 124. This tape feeder 20 accommodating the new supply reel 104 is stored, as the new tape feeder 20, at the storage location.

[0068] If there is still any tape feeder 20 to be replaced, a negative decision (NO) is obtained in step S112, and one cycle of execution of the program of Fig. ~~6~~ 7 is terminated. If all of the tape feeders 20 to be replaced have been replaced, an affirmative decision (YES) is obtained in step S112, and the control flow goes to step S113 to generate a signal to terminate the working operation by the operator, and reset the flag F2 to "0". In this sate, the first table 22 is held at the standby position, until the first table 22 is commanded to be moved to the common component-supply area, and operate to supply the electronic components, in place of the second table 23.

[0079] On the machine base 400, there is also disposed an electronic-component mounting device including a component mounting head 450 which will be described. The electronic components supplied by the electronic-component supply devices 406, 408 are mounted by the component mounting head 450, on the printed-wiring board 16 to produce a printed-circuit board. On the machine base 400, there are disposed two guide rails and two guide blocks (not shown) on the opposite sides of the printed-wiring-board conveyor 402, such that the guide rails and blocks extend in the X-axis direction, so as to slidably support an X-axis slide 412. As shown in Fig. 9, the X-axis slide 412 has a length enough to extend to the two electronic-component supply devices 406, 408, across the printed-wiring-board conveyor 402. The X-axis slide 412 has two ballnuts (not shown) fixed thereto and held in engagement with respective ballscrews 414. The X-axis slide 412 is moved in the X-axis direction in a horizontal XY plane, when the ballscrews 414 are rotated by respective two X-axis drive servomotors 416 operated in synchronization with each other. The ballnuts, ballscrews 414 and X-axis drive servomotors 416 cooperate to constitute an X-axis drive device 420, while the above-indicated guide rails and blocks constitute a guiding device for guiding the movement of the X-axis slide 412.

[0080] On the X-axis slide 412, there is disposed a Y-axis slide 430 such that the Y-axis slide 430 is movable in ~~a Y axis~~ the Y-axis direction perpendicular to the X-axis direction, in the XY plane. The X-axis slide 412 has a vertically extending side surface 432 on which there is fixedly disposed a ballscrew (not shown) extending in the Y-axis direction. The Y-axis slide 412 has a ballnut (not shown) fixed thereto and held in engagement with the ballscrew. The ballscrew is connected to a Y-axis drive servomotor 434 through gears 436,

438. With the ballscrew rotated by the servomotor 434, the Y-axis slide 412 is moved in the Y-axis direction while being guided by a pair of guide blocks 440 and a pair of guide rails 442. It will be understood that the ballscrew, ballnut and Y-axis drive servomotor 434 cooperate to constitute a Y-axis drive device, while the guide blocks 440 and guide rails 442 constitute a guiding device for guiding the movement of the Y-axis slide 430.

[0082] The Y-axis slide 430 carries the above-indicated component mounting head 450, and two image-taking devices in the form of a CCD camera 452 operable to take an image of the printed-wiring board 16 and a CCD camera 454 operable to take an image of the electronic component. The CCD camera 454 is disposed on an end portion of the Y-axis slide 430 extending in the X-axis direction, such that the CCD camera 454 is aligned with the component mounting head 450 in the Y-axis direction and faces downwards. The component mounting head 450 has a suction nozzle, which is movable to a desired position in the horizontal XY plane when the Y-axis slide 430 is moved to the corresponding position.

[0083] The X-axis slide 412 carries two reflecting devices 456 fixed thereto such that the two reflecting devices 456 are located above the respective ballscrews 414. When the Y-axis slide 430 is moved on the X-axis slide 412 in the Y-axis direction, the component mounting head 450 and the CCD camera 454 are moved past points right above the reflecting devices 456. The two reflecting devices 456 have respective light reflecting surfaces which are inclined in opposite directions by 45° with respect to the XY plane, so that the CCD camera 454 can take an image of the electronic component held by the component mounting head 450 when the head 450 is located right above one of the two reflecting devices 456.

[0086] The storage container 468 is formed of a transparent plastic material, so that the volume of the covering tape 102 accommodated in the storage container 468 can be detected by visual inspection by the operator. The storage container 468 has a pair of side walls 472, 473 opposed to and spaced from each other in the Y-axis direction. These side-~~wall~~ walls 472, 473 have a light-receiving body 478 and a light-emitting body 476, respectively, fixed thereto at their upper end portions. The light-receiving and light-emitting bodies 478, 476 cooperate to constitute a photoelectric sensor which serves as a covering-tape storage volume sensor 474 for detecting the volume of the covering tape 102 accommodated in the storage container 468. A light emitted by the light-emitting body 476 is received by the light-receiving body 478 unless the covering tape 102 within the storage container 468 prevents the light from being incident upon the light-receiving body 478. Described in detail, the entirety of the light emitted from the light-emitting body 476 is incident upon the light-receiving body 478 when the covering tape 102 does not exist above a level higher than a

straight line connecting the light-emitting and light-receiving bodies 476, 478. This level corresponds to an upper limit of the volume of the covering tape 102 accommodated in the storage container 468. As the level of the covering tape 102 is raised toward and above the above-indicated straight line, the amount of the light received by the light-receiving body 478 is reduced and eventually zeroed, depending upon how much the transmission of the light between the light-emitting and light-receiving bodies 476, 478 is disturbed by the covering tape 102. Accordingly, a determination as to whether the volume of the covering tape 102 accommodated within the storage container 468 is larger than the predetermined upper limit can be made depending upon whether the amount of the light received by the light-receiving body 478 is larger than a predetermined threshold.

[0088] In the present electronic-component mounting system, the reel support 108 of the tape feeder 410 is provided with a reel-mounting sensor 500 operable to detect that the supply reel 104 is mounted on the reel support 108, as shown in Fig. 11 which shows only the reel support 108 in enlargement. The reel-mounting sensor 500 is a photoelectric sensor including a light-emitting body 502 and a light-receiving body 504 which are spaced apart and opposed to each other in the Y-axis direction such that a straight line connecting these bodies 502, 504 lies within the interior of the reel support 108, so that the light emitted from the light-emitting body 502 reaches the light-receiving body 504 along this straight line unless the transmission of the light is disturbed by the roll of the carrier tape 100 wound on the supply reel 104. Described more specifically, the light emitted from the light-emitting body 502 does not reach the light-receiving body 504 when the diameter of the roll of the carrier tape 100 is larger than a predetermined lower limit, with a sufficiently large number of electronic components carried by the roll. When the diameter of the roll of the carrier tape 100 becomes smaller than the lower limit, with a decrease of the number of the electronic components carried by the roll, or when the supply reel 104 is removed from the reel support 108, the light is received by the light-receiving body 504, in the absence of the roll of the carrier tape 100 adjacent to the straight line connecting the light-emitting and light-receiving bodies 502, 504. Thus, the reel-mounting sensor 500 is arranged to detect the mounting of the supply reel 104 when the diameter of the roll of the carrier tape 100 wound on the supply reel 104 ~~has become smaller~~ is larger than the lower limit, and the absence or removal of the supply reel 104 when the supply reel 104 has been removed as a result of a decrease of the diameter of the roll of the carrier tape 100 below the predetermined lower limit. The reel-mounting sensor 500 detects the mounting of a new supply reel 104 with the roll of the carrier tape 100 having a diameter larger than the lower limit. Accordingly, the replacement

of the supply reel 104 with a new one can be detected by the control device 300, on the basis of generation of an output signal of the sensor 500 indicative of the removal of the presently mounted supply reel 104 and a subsequent change of the output signal upon mounting of the new supply reel 104.

[0092] The covering-tape removal assisting program of Fig. 12, which is executed for each of the tape feeders 410, is initiated with step S201 to determine whether a flag F4 is set at "0". If an affirmative decision (YES) is obtained in step S201, the control flow goes to step S202 to determine whether the output signal of the covering-tape storage volume sensor 474 indicates that the volume of the covering tape 102 accommodated in the storage container 468 has exceeded the predetermined upper limit. If an affirmative decision (YES) is obtained in step S202, the control flow goes to step S203 to turn on the first irradiating device 202 of the indicator-detector unit 208 corresponding to the tape feeder 410 in which the volume of the covering tape 102 in the storage container 468 has exceeded the upper limit. As a result, a selected portion of the relevant tape feeder 410 (for instance, the lid 480 of the storage container 468) is irradiated with the visible light emitted by the first irradiating device 202. Step S203 is further formulated to set the flag F4 to "1", so that steps S202 and S203 are subsequently skipped. Accordingly, the operator can recognize the tape feeder 410 which is irradiated with the visible light emitted by the irradiating device 202, and open the lid 480 of the storage container 468. The operator removes a suitable length of the covering tape 102 from the storage container 468, and cut off the covering tape 102 so that a suitable length of the covering tape 102 remains in the storage container 468. Although the second irradiating device 204 located below the first irradiating device 202 may be turned on simultaneously with the first irradiating device 202, this device 204 is not turned on in this embodiment, since the light emitted from the device 204 is not visible ~~unless~~ when the tape feeder 410 remains mounted on the support structure.

[0094] The upper limit of the storage volume of the covering tape 102 in the storage container 468 may be set to be comparatively small. In this case, a comparatively large length of the covering tape 102 can be still accommodated in the storage container ~~368~~ 468 even after the covering-tape storage volume sensor 474 has detected that the storage volume has exceeded the upper limit. In this case, therefore, the covering tape 102 need not be removed from the storage container 468 immediately after the detection that the storage volume has exceeded the upper limit, and may therefore be removed only when a predetermined condition is subsequently satisfied. For example, the ~~coveting~~ covering tape 102 is removed when a predetermined time has passed after the detection that the storage

volume has exceeded the upper limit, and/or when the number of the tape feeders 410 in which the storage volume of the covering tape 102 has exceeded the upper limit has become larger than a predetermined upper limit.

[0095] There will next be described the splicing operation by reference to the flow chart of Fig. 12 illustrating a splicing assisting program. This program is also executed for each of the tape feeders 410 of the electronic-component supply device 406, 408 which is presently used to supply the electronic components. In this example, the electronic-component supply device 406 is used. The splicing assisting program is initiated with step S301 to determine whether a flag F5 is set at "0". If an affirmative decision (YES) is obtained in step S301, the control flow goes to step S302 to determine whether the number of the electronic components accommodated in the carrier tape 100 has become smaller than a predetermined lower limit (whether all of the electronic components have been used). This determination in step S302 is effected on the basis of the output signal of the reel-mounting sensor 500. If an affirmative decision (YES) is obtained in step S302, the control flow goes to step S303 to determine that it is necessary to effect the splicing operation of the carrier tapes 100, and then to step S304 to ~~irradiate~~ turn on the first irradiating device 202 of the indicator-detector unit 208 corresponding to the relevant feeder 410, and set the flag F5 to "1". As a result, a portion of the relevant tape feeder 410 is irradiated with the visible light emitted by the irradiating device 202. In this case, the other electronic-component supply device 408 is used to supply the component mounting head 450 with the electronic components. In the present electronic-component mounting system wherein the electronic components are supplied by one of the two electronic-component supply devices 406, 408, the determination in step S308 of effecting the splicing operation in connection with any one of the tape feeders 410 of the presently used device 406 causes the other device 408 to be moved into the common component-supply area for supplying the component mounting head 450 with the electronic components, while moving the presently used device 406 to the standby position. Accordingly, the operator may perform the splicing operation on the relevant tape feeder 410.

[0099] The electronic components accommodated in trailing end portion of the presently used carrier tape 100 are not discarded but are eventually utilized after the splicing to the new carrier tape 100, the above-indicated lower limit of the diameter of the roll of the presently used carrier tape 100 may be set to be comparatively large. In this case, a comparatively large number of electronic components are still accommodated in the carrier tape 100 when the diameter of the roll has become smaller than the lower limit. In this case,

therefore, the presently used carrier tape 100 need not be spliced to the new carrier tape 100 immediately after the detection that the diameter of the roll has become smaller than the lower limit, and may therefore be spliced to the new carrier tape 100 only after a predetermined condition is subsequently satisfied. For example, the splicing operation is performed when a predetermined time has passed after the detection that the diameter of the roll has become smaller than the lower limit, and/or when the number of the tape feeders 410 in which the number of the remaining electronic components has become smaller than a predetermined lower limit has become larger than a predetermined upper limit. It is also possible to move the presently used electronic-component supply device 406, 408 to the standby position, and move the other supply device 406, 408 to the common component-supply area, when all of the electronic components in any one of the tape feeders 410 of the presently used supply device 406, 408 have been used. In this case, the splicing operation of the carrier tape 100 is effected for not only the tape feeder 410 whose electronic components have been used, but also any other tape feeders 410 in which the numbers of the remaining electronic components are smaller than a predetermined lower limit that is comparatively large.

[0101] The feeder replacing assisting program of Fig. 14 is executed when the control device 300 has detected in the main control routine that all of the electronic components in a given tape feeder 410 have been used or ~~when~~ that the number of the electronic components remaining in the tape feeder 410 has become smaller than the lower limit. The feeder replacement assisting program is initiated with step S401 to determine whether a flag F6 is set at "1". If an affirmative decision (YES) is obtained in step S401, the control flow goes to step S402 to determine that it is necessary to replace the tape feeder 410. Step S402 is followed by step S403 to move the component mounting head 450 from the electronic-component supply device 406, 408 including the relevant tape feeder 410, to the other supply device 406, 408. Then, the control flow goes to step S404 to turn on the first irradiating device 202 of the relevant indicator-detector unit 208 for irradiating a portion of the relevant tape feeder 410 with a visible light, so that the tape feeder 410 to be replaced is indicated by the visible light. Step S404 is further formulated to set the flag F6 to "1", so that steps S402-S404 are subsequently skipped. Step S404 is followed by step S405 to determine whether a flag F7 is set at "0". If an affirmative decision (YES) is obtained in step S405, the control flow goes to step S406 to determine whether the relevant tape feeder 410 has been removed. When the relevant tape feeder 410 has been removed by the operator, the photoelectric sensor 222 of the relevant indicator-detector unit 208 generates a signal

indicating that the relevant tape feeder 410 has been removed. As a result, an affirmative decision (YES) is obtained in step S406, and the control flow goes to step S407 to turn off the first irradiating device 202 and turn on the second irradiating device 204. ~~Since~~ Because the visible light emitted by the second irradiating device 204 is visible through the through-hole ~~164~~ 165 of the relevant slot 180, the operator can recognize that the relevant tape feeder 410 has been removed from the relevant slot 180. Step S407 is further formulated to reset the flag F7 to "1" so that steps S406 and S407 are subsequently skipped. If the wrong tape feeder 410 has been removed, the photoelectric sensor 222 corresponding to the wrong tape feeder 410 generates a signal indicating that this tape feeder 410 has been erroneously removed. As a result, a negative decision (NO) is obtained in step S406, and the control flow goes to step S408 to activate the irradiating devices 202, 204 corresponding to the wrong tape feeder 410 or slot 180, such that the irradiating devices 202, 204 flicker to informing the operator of the removal of the wrong tape feeder 410.

[0102] The position of the slot 180 in which the new tape feeder 410 is to be mounted is indicated by the visible light which is emitted by the corresponding second irradiating device 204 and which is visible through the corresponding through-hole 165. Accordingly, the operator is informed of the position of the relevant slot 180 in which the new tape feeder 410 is to be mounted. Step S407 is followed by step S409 to determine whether the bar code attached to the new tape feeder 410 identifies the identification number of the relevant slot 180, and step S410 to determine whether the new tape feeder 410 has been mounted in the relevant slot 180. If the new tape feeder 410 has been mounted in the relevant slot 180, this fact is detected by the photoelectric sensor 222 of the corresponding feeder-mounting device 206. If an affirmative decision (YES) is obtained in steps S409 and S410, the control flow goes to step S411 to turn off the second irradiating device 204, and reset the flags F6 and F7 to "0". Thus, the operator can confirm that the new tape feeder 410 has been mounted in the relevant slot 180. One cycle of execution of the program of Fig. 14 is terminated with step S411. If the wrong new tape feeder 410 has been mounted in the relevant slot 180 or if the relevant new tape feeder 410 has been mounted in the wrong slot 180, that is, if a negative decision (NO) is obtained in one of steps ~~S408~~ S409 and S410, the control flow goes to step S408 in which the irradiating devices 202, 204 corresponding to the wrong tape feeder 410 or slot 180 are activated so as to ~~flicker~~ irradiate. Thus, the operator is informed of the erroneous mounting of the new tape feeder 410. Where the new tape feeder 410 has been mounted in the wrong slot 180, the second irradiating device 204 is in the on

state so that the operator can easily recognize the position of the correct slot 180 in which the new tape feeder 410 should be re-mounted.

[0103] It will be understood from the foregoing description of the present second embodiment that each of the covering-tape storage volume sensor 474 and the reel-mounting sensor 500 constitutes a need detecting device operable to detect a need of performing an intermediate manual working operation, and that a portion of the control device 300 assigned to implement steps S203-S205 of Fig. 12 and steps S304-306 of Fig. 13 constitutes an intermediate-operation checking and indicating device. It will also be understood that a portion of the control device 300 assigned to implement steps S408 and S410 of Fig. 14 constitutes a mounting-position checking and indicating device, while a portion of the control device 300 assigned to implement steps ~~S40&~~ S406 and S408 of Fig. 14 constitutes a removing-position checking and indicating device.

[0106] Although the two electronic-component supply devices 406, 408 are provided in the second embodiment, the electronic-component mounting system may be provided with only one of the two supply devices ~~405, 508~~ 406, 408. In this case, the intermediate working operations can be performed while the supply device is in operation to supply the electronic components to be mounted on the printed-wiring board 16. However, the replacement of the tape feeders 410 is preferably performed while the operation to mount the electronic components on the board 16 is interrupted.